

COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN No. 28.

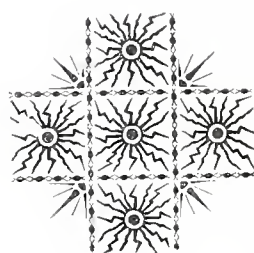
THE FUNGOUS FOES OF THE FARMER.

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PUBLISHED BY DIRECTION OF THE SECRETARY.

WM. STANLEY RAY,
STATE PRINTER OF PENNSYLVANIA.
1897.



COMMONWEALTH OF PENNSYLVANIA,
OFFICE DEPARTMENT OF AGRICULTURE,
HARRISBURG, PA., November 30, 1897.

The accompanying Bulletin is issued under the provisions of section 6 of the act of March 13, 1895 (to establish the Department of Agriculture), which provides "That the Secretary may at his discretion employ experts for special examinations or investigations."

In the selection of topics for these investigations, care has been taken to order investigations into subjects which will interest the general farmer, and to have them presented in such a manner as will enable the average farmer to become interested in them; to this end scientific terms have, so far as possible, been avoided, and language made use of which is readily understood.

Prof. Halsted was selected for the investigation of the topic to which this Bulletin relates, because of his eminent fitness for the work, and this Bulletin is offered as an explanation of a number of forms of life which, while they more or less affect the farmer and his crops, are at the same time but little understood by him.

THOS. J. EDGE,
Secretary.



THE FUNGOUS FOES OF THE FARMER.

By Prof. Byron D. Halsted, D. Sc., New Brunswick, N. J.

The farmer has many foes and the fungi are not among the least of them. They begin their destructive work at the opening of the growing season and do not close their activities for winter until late in the autumn. They thrive upon every crop the farmer grows from the smut in the corn to the mildew upon his lettuce, from the potato rot to the rust of the wheat and the blight of the apples and pears.

These fungi are obscure, because usually so very small, and a full knowledge of them is gained only after prolonged study with the compound microscope. They are, in short, minute plants that have no roots, stems or leaves and consist of fine threads that increase in length often with considerable rapidity and may form structures of considerable size by the filaments uniting with each other like the fibres in a rope.

Among the more conspicuous fungi are the mushrooms, toadstools and puff balls that appear in the pasture or upon old logs. If a toadstool is examined it will be found to consist of the stalk and cap, the latter with many gills upon the underside reaching from the top of the stalk to the rim of the cap. Upon these gills small oval bodies are produced in great numbers. In some toadstools the gills are brown or pink, white or almost any other color, depending upon the tint of the spores. This can be determined with ease by removing the cap and placing it upon paper where the spores will fall in a few minutes in sufficient numbers to give a "print" of the gills. If the spores are white a black paper is best to show them, and a white paper for the same reason is best when the spores are dark. The color of the mature gills will suggest the best paper upon which to lay the caps in making these "spore prints."

The above illustration is given in order that the reader may gain

The six engravings herein used, first appeared in the reports of the New Jersey College Experiment Station.—B. D. H.

a practical lesson, if he will, in the great numbers of spores that fungi produce. These spores are the reproductive bodies of the fungi, and while exceedingly small vary greatly in many ways. They answer to the seeds in higher plants and while differing from seeds in their structure, size, etc., are able, under favorable conditions of developing into new plants similar to the ones producing them.

There are many kinds of plants aside from fungi that produce spores instead of seeds and all such are flowerless and therefore never have any blossoms. Among the large plants that bear spores are the ferns, some of which attain to the size of trees in the warmer regions of the globe. With us the ferns are herbs of good size, and if the reader will examine them the spores may be found upon the underside of the large leaves in small spots of various shapes and known as the spore-spots. Other ferns have the spores produced along the infolded edges of the leaves, and in some the spore-bearing leaves are quite different from those that never produce them.

The mosses form another large group of very leafy green plants that have no flowers and form the spores in small cups that are produced upon the tips of slender stalks. Another group of spore-bearing plants is the scouring rushes or horsetails. Enough has been written to show that the fungi have related groups of plants, all of which agree in bearing spores instead of producing flowers and seeds.

Fungi are not easily defined and with the preliminaries as above stated a further knowledge of them will be given by means of examples, the selection being made from those that are the most troublesome to the crop grower.

FUNGUS FOES OF FARM CROPS.

The corn smut (*Ustilago maydis* Pers), is a well known fungus enemy to the farmer which appears upon the ear, tassel, leaves and even stems and roots of the corn plant. Multitudes of brown spores are produced, and it is these that make up the brown powder so abundant when the smutted ear is dry. As in the toadstool so here there are two chief portions of the smut fungus, namely, the threads and the spores. The latter remain over the winter wherever they may chance to lodge, and if surrounded by favorable conditions for germination will produce threads in the spring. It has been determined that a rich moist warm situation like a manure heap is an excellent place for smut spores to grow and they there produce multitudes of other spores which, when they find their way to the young corn plants, will inoculate them with smut. These spores falling upon the surface of the corn leaf or young stem, will germinate and send their slender threads into the substance of the plant, and when once within they thrive upon the juices there found, of course, at the

expense of the young corn plant. After some time, and it may be weeks, the fungus prepares for a spore production, which as a rule takes place in the young grains, but other places may bear the sooty masses of spores as the tassel, bases of the leaves, etc. The young grains, already infested with the fungus, enlarge rapidly, become greatly distorted, break out through the husks and the dropping ear is a mass of smut not unfamiliar to farmers.

From the nature of the disease and its habits of wintering and germination in the spring it is evident that the first thing to do in checking the trouble consists in destroying the spores as fully as possible. This may be done by cutting out the smutted ears, tassels and other parts of the corn plant and burning them. It would be worse than useless to cast the smutted portions into the manure heaps, for there the spores germinate and multiply greatly, producing spores in the most favorable place for transportation to the field when they would be quite certain to reproduce the smut upon the corn.

Spraying, to be considered later, is not practicable with this fungus, and the method suggested above is the one to be pursued.

The smut is sometimes very prevalent upon sweet corn and then it may be necessary to grow other crops for a term of years upon land long in corn that has become much contaminated with the spores.

Nearly all the small grains are now attacked more or less with smut, that upon the oats (*Ustilago Avenae* Jen.), being perhaps the most common, and taking the whole country through shortens the oat crop considerably. This fungus makes its attack upon the plant when the latter is small—while it is a seedling, and by spores that are adhering to the grain. From these facts an effective and cheap remedy has been worked out consisting in the destruction of the smut spores that may be upon the seed grain at time of sowing. The oats to be sown are placed in water hot enough to kill the spores and not injure the grains. This is known as the Jansen method, from the Danish discoverer and may be employed upon a large or small scale, according to circumstances. Two vessels are employed for holding the water, one with a temperature of 130 degrees and into this the dry oats in gunny sack or basket are placed until heated throughout the mass. From this vessel the oats in the sac or basket are taken to the second vessel where the water is kept uniformly near and not above 135 degrees and left to scald for fifteen minutes, after which the grain is spread out to dry and then sown or stored until needed for seed.

The wheat smut (*Ustilago Tritici* Jen), is similar to that of oats in that its spore-bearing portion is confined to the grains and therefore seems to affect only the heads of the wheat, while in fact the plants become inoculated through the seedling stems close to the ground,

and the whole stool is infested, discolored and dwarfed by the fungus. The same method of treatment as for oat smut is now used with marked success, but on account of less covering to the grain, a somewhat lower temperature is best, not heating the water in the second vessel above 127 degrees F. In employing this method a thermometer should be in constant use to determine the temperature of the water in the vessels, for if too low the spores will not be killed and if too high the grain will be injured.

Other methods of destroying the adhering smut spores have been in use for a long time, as for example blue stone (copper sulphate), one pound in twenty-five gallons of water in which the seed wheat was soaked for a half hour or less. The latest recommendation for oats is the use of a solution of potassium sulphide in one half per cent. solution, that is, a pound to two hundred (25 gallons) of water.

Ergot (*Claviceps purpurea* Tul.), is the most remarkable fungus of the grain fields. Its favorite plant is the rye, but may appear in wheat, barley and many of the grasses, and always confines itself to the heads when it causes the grains to become greatly enlarged and hard as horn. Upon the rye these grains, from their resemblance in size, shape and hardness to the spurs of cocks, have received the common name of "spurred rye." These spurred grains several times the size of the natural grains possess the very active principle, ergotine, that may cause disease (Ergotism), and death in animals and man. Ergotism is quite abundant in some countries, but there is but little of it as a rule in the United States.

FUNGOUS FOES OF ROOT CROPS.

Among the root crops of the field and garden there are several fungous diseases of great destructiveness. The club-root of the turnip is caused by a slime mould (*Plasmodophora Brassicae* Wor.), and receives its common name from the fact that abnormal enlargements of the roots are produced and the plant's feeding capacity is so reduced thereby as to cause ruin. The fungus is without filaments and multiplies in the cells of the roots, causing them to grow out of the natural shape and soon decay with a very disagreeable odor. The fungus resides in the soil and therefore any treatment that is given needs to be applied to the soil, instead of the plants. It has been found that upon land that is infested with this disease slaked lime is quite effective applied to the soil at the rate of seventy-five bushels per acre. This application may be made the autumn before and left upon the surface until plowed under in the spring.

Cabbage is equally susceptible with turnips to this club-root and the failure of this crop may often be traced to this cause. The same

soil treatment is advised as for turnips, and it goes without argument that when a piece of land fails with a crop of turnips by clubbing it should not be followed by cabbages, unless thoroughly limed.



Fig. 1 -- Young Cabbage Plants—Showing Club-root in a Serious Form.

Figure 1 shows three young cabbage plants that are badly clubbed, the engraving being made from a photograph of the diseased plants.

The sweet potato has several fungous diseases that work upon the roots, the leading ones being the Soil Rot, the Black Rot and the Soft Rot. When affected with the soil rot the plants show a lack of vigor and an examination of the roots reveals the certain marks of the disease. The roots attacked when young and fibrous become constricted and dark at a few places and are somewhat neck-lace formed. Roots also of considerable size may have brown, sunken patches where the fungus has destroyed the tissue of the potato. The soil rot germs are in the earth and a field crop may become so infested as to make sweet potato growing unprofitable upon that land.

A number of substances have been tested in seeking for a remedy, but none of them give such favorable results as flowers of sulphur

sprinkled in the open row where the plants are to be afterwards set. This powder, at the rate of three hundred pounds per acre, can be added rapidly with the ordinary fertilizer drill, and along with the fertilizer if any is applied.

The Black Rot (*Ceratocystis fimbriata* E. & Hals.), as its common name indicates, produces dark markings upon the sweet potatoes and may spread with age and include the whole root. It begins in the hot bed and is recognized upon the sprouts as dark lines near the base. All such sprouts should be rejected and great care taken that only the most healthful roots are used for the production of sprouts.

A third form of rot of the sweet potato is produced by a mould (*Rhizopus nigricans* Ehrh), that develops rarely before harvest but often to a great extent in the storage bins. This fungus thrives in moisture and the time of greatest destruction is while the potatoes are passing the sweating period. To save the roots at this time it is well to have the store room thoroughly ventilated and kept to about seventy degrees by means of artificial heat. This dries off the moisture that gathers upon the roots and the mould is less apt to start. When once it gets into a bin or barrel it runs through the potatoes with amazing rapidity, reducing them to a soft, dark mass.

The round or Irish potato is subject to several fungus diseases, two of which are termed blights. As one (*Macrosporium Solani* E. & M.), usually comes before the other, it is called Early Blight. This is recognized by the dark, irregular circular patches upon the foliage, and when left to itself under favoring conditions, will denude the vines and greatly shorten the crop.

The Bordeaux mixture, made by adding a solution of six pounds of copper sulphate in twenty-five gallons of water to four pounds of lime slaked and diluted in twenty-five gallons also of water. This bluish mixture may be applied to the potato vines by means of a spraying machine drawn by a horse or team and covering at least four rows at a time. The Bordeaux mixture can have the Paris green or London purple added and applied at the same time, thus checking the blight and the insects at one spraying.

The Late Blight (*Phytophthora infestans* D. By), is a very fatal disease when it has an opportunity to run its course. It first appears as a mildew upon the foliage and from there it passes down the succulent stems to the tubers, which soon decay. This is the cause of the famine-producing rot of historic interest in Ireland. Spraying will check this disease, but when the vines are badly attacked and the potatoes are nearly mature the crop should be harvested. Early varieties often escape the late blight.

There is a bacterial blight of potatoes of considerable severity. The affected tubers turn brown, become soft and melt down into an offensive mass of rottenness. Great care needs to be exercised in

selecting healthy seed and successive crops should not be attempted upon affected soil.

The leading trouble with potatoes in many localities is the Scab, produced by a fungus *Oospora Scabies* Thax. It attacks the tubers while they are quite young, and will continue to grow so long as moisture is upon the surface of the potato. The scab is quickly recognized by the rough coat of the tuber which is broken by ill defined spots and pits, and when first removed from the soil the injured parts are covered with a fine lead-colored mould. This fungus remains over from one season to another in the soil and is communicated to new potatoes from scabby seed. This suggests that only potatoes free from the disease should be used for seed, and if there is doubt the potatoes before being cut may be soaked for two hours in a solution of corrosive sublimate to eight gallons of water. When the soil contains the germs, which is usually the case, flowers of sulphur may be added in the open row at the rate of three hundred pounds per acre.



Fig. 2. A Pile of Scabby Potatoes.

Figure 2 shows a group of scabby potatoes taken from a field where no treatment had been applied.

The Scab of the beet is due to the same fungus as that causing the potato scab, and is becoming common in some localities. Upon the beets the affected parts are quite unlike those of the potato, and when the beet is a long one there is a well marked zone where the scab is located beginning about two inches below the surface.

There could scarcely be any seed treatment in case of the beets, but sulphur added to the soil may be of value. The leading fact to

make use of is that such distantly related plants as potatoes and beets are attacked by the same fungus and consequently these crops should not succeed each other when the scab prevails in either.

This is a fungus that is easily controlled by spraying.



Fig.3. Small Beet Leaf—Showing the Leaf Spot.

There is a leaf blight of the beet that has become very serious in many places. This is due to the fungus *Cercospora beticola* Sacc., and is quickly recognized by the many spots upon, followed by holes that it makes in, the leaves. Figure 3 shows a badly blighted beet leaf made from a sun print and shows everything of natural size. This is a fungus trouble of the ordinary sort, closely related to a blight of the celery and consists of threads that starting from the surface grow through the tissue and coming to the surface again produce a new crop of spores.

FUNGUS FOES IN THE ORCHARD.

If the fungi injurious to orchard fruits are considered, one of the first, from its conspicuousness, is the apple rust, due to the inroads of a fungus with a very long name, *Gymnosporangium macropus* L.. In general appearance a rusty orchard is easily recognized by the orange color which sometimes is seen from miles away. The rust appears in spots upon the leaves and stems, even the fruit sometimes being attacked. The orange spots produce a cluster of long, deep cups in which the spores are produced.

There is an interesting double life in the existence of this fungus, it thriving upon two widely different plants during the year. The spores produced in the cups in the apple leaf in summer pass to the cedar trees when they develop small chocolate-colored galls that remain until the next spring, when they enlarge very much, produce orange colored gelatinous horns with multitudes of spores that are carried to the apple trees, and then cause the rust.

Sometimes when a cedar tree is standing near an orchard it can be seen to be the centre of infection, and occasionally the rust is almost entirely upon the lea side of the cedar tree when the prevailing winds blow in one direction.

The remedy is, first of all, to remove the cedar trees and the next best is to pick and burn the galls from the cedars in winter or early spring and burn them. Spraying the orchard with a standard fungicide may prove effective, but as yet but few experiments have been made.

The apple scab (*Fusicladium dendriticum* Fcl.), is a fungus that attacks both the foliage and fruit, producing irregular patches upon the former that turn from light green to brown and become raised upon the underside. Upon the fruit the spots are more regular and usually possess a light gray border. If the attack is made when the fruit is small it causes a dwarfing of the specimen that may develop upon one side only, and become distorted, cracked and worthless.

This fungus is not a deep feeder, but growing just below the skin, and breaking it, develops the innumerable spores which germinate quickly and spread the trouble with rapidity.

Spraying can be resorted to with profitable results and should begin before the blossoms open, followed by at least three intervals of two or three weeks after the petals fall. Bordeaux has been used for the apple scab with excellent results.

The Fire Blight of the apple, pear and quince is a very destructive enemy in the orchard. It is easily recognized by the sudden wilting of the foliage in midsummer, its turning brown and the dying of the twigs as if scorched by a fire.

This blight is due to a micro-organism that winters over in the twigs and the individual germs escaping with the gum oozing from a diseased spot may spread to a tender opening bud, or is carried to a blossom by a bee and a new seat of infection is thereby established. In the apple it is not unusual to find nearly all the flower-clusters blighted and the leaf-bearing twigs may escape in large part.

In the pear the blight runs down the stems more rapidly than in the apple from leaf buds at their extremity. No variety is exempt from this disease, but some, as the Bartletts, are more susceptible than others. The Keiffer, once thought to be free from the trouble, is in later years showing much of the blight.

There is a "body blight" that causes dead patches in the main stems which is due to the micro-organism above mentioned.

The treatment of most value is severe pruning of the blighted portions whenever met with in the orchard, and burning the brush thus secured. The germs are very small and numerous and spraying has not proved effective.

There is a Leaf Blight of the pear that causes the affected tree to lose its foliage and stand leafless for months in autumn. This fungus, *Entomosporium maculatum* Lev., first causes discolored spots upon the foliage which enlarge and results in defoliation of the tree. The fruit is also attacked and remains small, becoming distorted and frequently cracked.

This trouble is easily controlled by fungicides and pear growers are using cart sprayers in the orchards with good results. While Bordeaux may be used for the early sprayings, a clear liquid as cupram is better when the fruit is reaching maturity.

The Black Knot of the plum and cherry is caused by one of the most conspicuous and destructive of the fungi of the orchard, and its presence is easily recognized by the large, rough, nearly black excrescences produced upon the branches. The fungus (*Plowrightia morbosa*, Sacc.), makes its attack upon the surface of the young twigs and the small knots there formed grow for several years or until the branch may be ruined.

This fungus produces its spores upon the surface of the young knots and also a second form within the substance of old ones, so that there is a chance of destroying it by spraying in the first case, but not less so in the second. The experiments thus far made indicate that the best treatment is the removal of the knots with knife or saw and burning them. Often the same kind of knots are produced upon wild cherry and plum trees and these need to be destroyed before the related orchard trees may be free from inoculation that may come from the forest or hedge row.

There is another fungus (*Exoascus pruni* Fl.), that is closely related to the one producing the black knot that causes the young plums to become much enlarged, soft and frequently hollow; stems and leaves may also be distorted with the same enemy. The treatment is similar to that recommended for the black knot. In cutting, the knife should, in all instances, pass several inches below the least sign of the knot or else the disease will continue to grow and form a knot upon the stub.

Under cherries the leading fungous enemy is the Brown Rot, caused by the *Monilia fructigena* Pers., which preys chiefly upon the fruit and, as its common name indicates, causes the affected part to become coated with a gray powder, the spores of the fungus. This is the most rapid growing of all the fungi injurious to farm and orchard crops, clothing in a day, if it be moist and hot, the surface of maturing fruit with the ashy substance. The growth is so rapid that when the conditions of moist atmosphere and ripe fruit obtain it is almost impossible to check it. However, good results have resulted from thorough sprayings of a fungicide.

The same fungus thrives upon both the plum and the peach, and

upon the latter the fruit dries down and mummifies upon the stem and the fungus frequently spreads from the fruit to the branch bearing it, and the leaves turn brown and die. In such cases it is best to remove the dead branches to the burn heap or else the fungus will spread far down the stems.

The leading fungus disease of the peach, other than those already described under cherry and plum, is the Leaf Curl, due to *Exoascus deformans* Fl. This fungus causes the foliage to become discolored, red or yellow, and puckered out of the natural shape. Sometimes only a single branch will bear the curled foliage and such should be removed. When confined to a few trees the trouble can be controlled with the pruning knife.

The Black Spot (*Cladosporium carpophyllum* Thum.) is a serious fungus upon the fruit, causing it to become spotted and dwarfed, followed by cracks and decay. It is likely that spraying would check this enemy, but the peach foliage is among the most sensitive of all plants and fungicides need to be used upon it with great caution.

The last enemy of the peach to be here mentioned, and by no means the least, is the "Yellows." It is recognized by the premature ripening of the fruit, which takes on an unnatural spotting of red and purple, streaked with the same color through the flesh from skin to pit, and a bitter or insipid taste. Tufts of small branches are produced upon the stems similar to "water sprouts" in fruit trees generally, but with slender yellow leaves of small size.

FUNGUS FOES OF SMALL FRUIT.

The farmer experiences the destructive effects of fungi upon his grape vines. They may attack the foliage causing frosty patches, as the downy mildew (*Peronospora viticola* D. By.) The berries, when attacked while still small and green, turn brown and are ruined.

There is a powdery mildew (*Uncinula Spiralis* B. & C.) that thrives in the vineyard and is particularly disastrous to the grape industry in Europe.

The Black Rot (*Laestadia Bidwellii* V. & R.), is the leading fungus enemy of the grape and attacks the leaves, young canes and fruit, causing spots in the first and a black decay in the last, with fine pimples over the surface of the shrivelled fruit. Dark sunken spots are produced upon the canes, and in its worst form the whole vine is ruined.

These troubles may be kept down by spraying with Bordeaux or later in the season, when the berries near maturity, a clear fungicide.

may be used to avoid the lime of the Bordeaux as an objectionable coating to the fruit.

Among blackberries and raspberries the most destructive fungus foe is the Rust (*Puccinia Peckiana* Howe). This is readily detected in the upright position of the affected canes and the shiny leaves which later become orange-colored upon the under side from the exposure of the vast multitude of the spores. This fungus, like nearly all of its large class is very deeply seated and fills the whole plant with its threads before showing itself in the conspicuous spore-bearing condition. It follows, therefore, that spraying has not proved effective, and the best recommendation is the knife and the burn heap.

There is an anthracnose (*Gloeosporium venetum* Speg.), at times that attacks the canes and greatly shortens the crop. Good results have followed the winter treatment of the canes with copper sulphate and summer spraying with Bordeaux.

Currants and gooseberries are troubled by a leaf spot (*Septoria ribis* Desm.) and anthracnose (*Gloeosporium ribis* M. & D.), both recognized by the dark spots upon the foliage, followed by a dropping of the leaves. The treatment is the same as for the last fungus mentioned.

The gooseberry is particularly susceptible to mildew, and it has rendered the growing of European sorts precarious with use. This mildew forms a thick felt upon the tips of canes, including the leaves, and also upon the fruit. Sulphide of potassium, a half ounce to a gallon of water, has been used as a remedy for this trouble with marked success.

The strawberry has its share of fungous enemies, but none are more common than the leaf spot, sometimes called strawberry blight (*Sphaerella fragariae* Sacc.), which are known to nearly all by the round, ashy spots with purple border seen upon the foliage. Many remedies have been used, but removing the old leaves and burning them after harvest is quite effective. This will give the new, fresh foliage a chance to form and do its work. A frequent change of place of the bed is a good precautionary measure.

FUNGOUS FOES OF VEGETABLE FRUITS.

The vegetable fruits have many fungus enemies, as for example, the bean with its Anthracnose (*Colletotrichum lagenarium* Pass). This shows itself early in the growth of the plant upon the foliage as narrow often purplish lines along the main veins, and later attacks the pods, producing the pits called the "pod spot." Figure 4 shows three badly spotted beanpods from the golden wax variety. This is one of the fungi that is easily controlled by spraying.

A second leaf and pod disease of the bean is the Bacteriosis, due to a micro-organism that produces watery areas in the foliage that soon dry up and break away. Upon the pods it forms water logged spots that become ulcers when the fruit is worthless. The conditions of the weather seem to influence the development of the bacteriosis, a moist, warm spell being favorable to it.

The lima beans suffer from a genuine mildew that coats the pods with a white covering and ruins the crop. This is comparatively new and as yet but little in the way of remedial experiments have been made.

Peas are much troubled by a blight upon the leaves and fruit, blotching both and shortening the crop. This is due to a fungus (*Ascochyta pisi* Lev.) that is not easily controlled by fungicides. The late peas are usually attacked by a mildew (*Erysiphe Martii* Lev.) and is so common that only early peas are usually grown on account of it. Bordeaux sprayings may be applied with success for the mildew.

Tomatoes have a number of fungus diseases, but the leading one of late years is the Leaf Spot due to the *Septoria Lycopersici* Speg., recognized by the numerous small circular spots upon leaves and stems, followed by a loss of foliage and the ruin of the crop. The general appearance of a diseased leaf is shown in figure 5. This fungus begins its destructive work in the bed before the plants are set in the field and the remedy should be first applied, then growers of plants should cleanse their beds or make new ones, and if set in a new place it will be an advantage.

There is a blight of the foliage, due to *Clasosporium fulvum* Cke., which produces olive brown velvety patches upon the foliage. It is more common than any other fungus enemy to the tomatoes grown under glass.

There is a black rot, due to *Macrosporium tomato* Cke., that works at the blossom end of the fruit and produces black spots, followed by cracking and a soft rot.



Fig. 4. Wax Beans badly attacked by Anthracnose.

Bacteriosis of tomato plants is due to a micro-organism that causes a wilting of the foliage and watery stripes upon the stem. The same

bacterium produces a similar condition in potatoes and egg plants, and as the germs may be stored in the soil, these crops, if infected, should not succeed each other. A judicious rotation of crops is a cleansing factor in farm and garden economy.

Egg plants are more troubled from the Leaf Spot fungus (*Phyllosticta hortorum* Speg.), than any other. It produces large, irregular, brown patches in the leaves and similar blotches in the maturing fruit, causing the latter to decay with much more rapidity. Plants that are badly diseased rarely produce fruit and may perish in the seed bed when the fungus attacks the plants, and causes a destructive "damping off."



Fig. 5. Tomato Leaf—Showing Leaf Spot.

Melons and cucumbers are troubled with two fungi that often destroy the crop, namely, the mildew (*P. cismofaria* *Cubensis* B. & C.), and the anthracnose (*Colletotrichum laginarium* Pass.). The former produces yellow patches in the leaves, and the latter forms ulcers in the fruit. Figure 6 shows a cucumber that before fully grown had been ruined by the anthracnose.

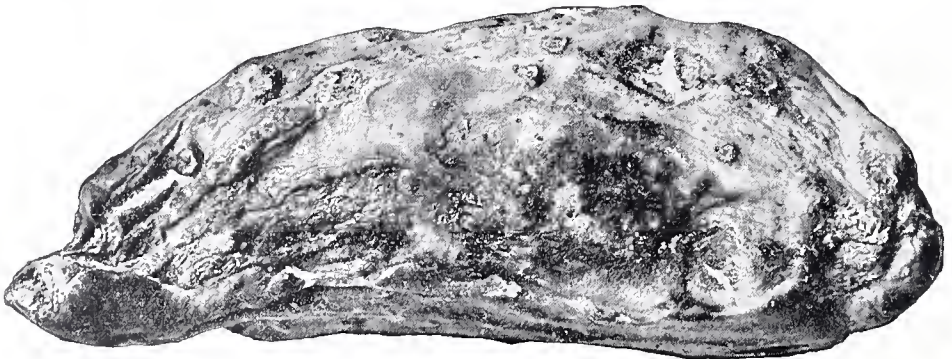


Fig. 6.—A Cucumber destroyed by Anthracnose.

FUNGUS FOES TO VEGETABLES.

Celery has a number of fungus enemies, the leading of which is the blight or "Rust," so-called, (*Cercospora Apii* Fr.), known by the light brown spots produced upon the foliage, which may coil up and turn gray with the spores of the fungus. Bordeaux is easily applied and quite effective. Shading the plants seems to favor the crop and not the fungus.

There is a bacteriosis that attacks the celery usually after it is stored and destroys the tender heart of the plant. No remedy has been devised for this and care needs to be taken to keep the plants from excess of warmth and moisture while stored.

Spinach has two leading fungi; the mildew (*Peronospora effusa* Raben), and the anthracnose (*Colletotrichum spinacaciae* E. & Hals), the former producing violet velvety patches upon the foliage and the latter brown circular blotches.

Only clear fungicides would answer upon the spinach, as anything like the Bordeaux mixture would soil the looks of the plants for market.

Onions have as their chief fungous enemy the smut (*Urocystis Cepulae* Fr.), easily detected by the blackish masses of spores produced in the bulbs and foliage above. When the soil becomes infested with the spores a mixture of equal parts of sulphur and lime sprinkled in the row at the rate of three or four hundred pounds per acre is found effective. Better still, land that is known to be smutty should be given to some other crop and only returned to onions after several years.

Asparagus has a new and serious rust preying upon it. This fungus (*Puccinia Asparagi* D. C.), is recognized by the premature browning of the brush, the stems being blistered and showing numerous spots of a reddish or dark brown color.

While spraying has given some favorable results it is best to cut and burn the rusted plants so soon as they become at all brown in appearance.

It has been the purpose of this paper to briefly describe the worst fungous disease of the farmer's crops and give methods that have been successful in checking them. As far as possible the fungi have been considered in the order of their importance with each crop, beginning with those of the field and ending with those of the garden.

